REMOVAL PERFORMANCE OF POLLUTANTS FROM INDUSTRIAL WASTEWATER USING *SCIRPUS GROSSUS*

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I hereby declare that I have checked this thesis/project and in my opinion this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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for the award of the
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DEDICATION

Special dedications to,

My beloved father, MATHURAVEERAN S/O NADASON

My beloved mother, SIVAPAGIAM D/O KANDASAMY

My beloved siblings, VENMALAR D/O MATHURAVEERAN

THAMARAI D/O MATHURAVEERAN

GANAATIBAN S/O MATHURAVEERAN

My supervisor, Dr Mir Sujaul Islam, UMP Lecturers and all my fellow friends.

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ABSTRAK

Dalam era teknologi moden dan kompleks ini, pencemaran adalah kebimbangan terbesar di dunia. Pencemaran udara, pencemaran air, pencemaran tanah dan banyak lagi telah menjadi masalah yang teruk kepada dunia untuk menangi. Pencemaran air merupakan satu masalah serius di Malaysia dan memberi impak negatif terhadap kelestarian sumber air. 'Phytoremediation' adalah rawatan terbaik untuk air kumbahan tercemar. Rawatan ini adalah murah, mudah untuk penyeleggaraan dan ekonomi. Selain itu, 'phytoremediation' adalah teknologi baru yang harus dipertimbangkan untuk pemulihan tapak tercemar kerana kelebihan estetika dan kebolehgunaan jangka panjang. Objektif projek ini adalah untuk mengenal pasti label bahan pencemar, yang mengandungi air sisa industry untuk maklumat asas dan untuk menentukan keberkesanan 'phytoremediation' *scirpus grossus* untuk mengeluarkan bahan pencemar yang terkandung di dalam air kumbahan. *Scirpus Grossus* digunakan untuk mengetahui keupayaan penyingkiran yang terdapat dalam air sisa industri. Eksperimen ini dijalankan selama satu bulan dengan mengenal pasti parameter in-situ dan ex-situ di Makmal Alam Sekitar Universiti Malaysia Pahang. Air kumbahan telah dikumpulkan dari kawasan kajian dan dianalisis untuk mengumpul data kualiti air. Parameter yang diuji ialah pH, *dissolved oxygen* (DO), suhu, kekeruhan, *Biological Oxygen Demand* (BOD), *Chemical Oxygen Demand* (COD), *Total Suspended Solid* (TSS), *ammoniacal nitrogen*, *cadmium* (Cd), *zinc* (Zn) and *iron* (Fe). Berdasarkan uji kaji, kapasiti penyingkiran lebih tinggi apabila pengenceran 50% pencairan, iaitu untuk kekeruhan, BOD, COD, TSS, *ammoniacal nitrogen* dan Zn adalah 69.33%, 69.92%, 81.48%, 64.63%, 68.36% 64.29% masing-masing. Cd adalah 70.59% untuk pencairan 70% manakala Fe adalah 81.94% untuk 100% tanpa pencairan. *Scirpus Grossus* tidak berkesan tanpa pencairan. Kapasiti penyingkiran adalah lebih tinggi apabila pengenceran 50% air sisa selepas rawatan satu bulan.

ABSTRACT

In this era of complex and modern technology, pollution is the biggest fear in world. Air pollution, water pollution, soil pollution and many more have become a severe problem to the world to cope with. Water pollution is a serious problem in Malaysia and impact negatively on the sustainability of water resources. Phytoremediation is the best treatment for the contaminant wastewater. This treatment is cheap, easy to maintenance and economical. Besides that, phytoremediation is an emerging technology that should be considered for the remediation of contaminated sites because of its aesthetic advantages and long-term applicability. The objectives of this study was to identify the label of pollutant contains in industrial wastewater for baseline information and to determine the effectiveness of phytoremediation plant (*scirpus grossus*) to remove the pollutant contains in wastewater. *Scirpus Grossus* (club-rush) was used to find out removal capacity that contain in industrial wastewater. The experiment was run for one month by identify the in-situ and ex-situ parameters at Environmental Laboratory of Universiti Malaysia Pahang. The wastewater was collected from the study area and was analysed to collect the water quality data. The experiment was carried out for one-month duration with average of 3 measurements for each percentage. The parameters that was tested were pH, dissolved oxygen (DO), temperature, turbidity, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), ammoniacal nitrogen, cadmium (Cd), zinc (Zn) and iron (Fe). Based on the experiment, the removal capacity was higher when the 50% dilution of the dilution, which was for turbidity, BOD, COD, TSS, ammoniacal nitrogen and Zn were 69.33%, 69.92%, 81.48%, 64.63%, 68.36%, 64.29% respectively. Cd was 70.59% for 70% dilution while Fe was 81.94% for 100% without dilution. *Scirpus Grossus* was not effective without dilution. The removal capacity was higher when the 50% dilution of the wastewater after one month treatment.

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LIST OF ABBREVIATIONS

AN	Ammoniacal Nitrogen
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
Cd	Cadmium
Cr	Chromium
Cu	Copper
DO	Dissolved Oxygen
Fe	Iron
Hg	Mercury
Ni	Nickel
Pb	Lead
TSS	Total Suspended Solid
Zn	Zinc

CHAPTER 1

INTRODUCTION

1.1 Introduction

Water can be found all over the place thus it is more than 70 percent of the planet's surface. All living beings on the earth are unable to survive without water. None of us can live without water even for one day. On the earth, there are very less percentage of drinking water. From this, we should understand and save the water and also do not waste the clean water for future generations. The availability of oxygen and water only can be found at earth planet where life is available. Water is a common need for our body plus our life. It is the most demanding requirement in all life especially all the field of work environment such as agriculture, industry, household, domestic and many more. As all know, water does not have odour, colour, shape and taste yet it contributes in all living things. Throughout the world, water is under threat from depletion, pollution and mismanagement affected by human activities. Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels. Water pollution is unsafe to the living beings. Wastewater means "used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff and any sewer inflow or sewer infiltration (Tilley et al. 2016).

Multidirectional developmental activities, for improved quality of life have increased the quantity of wastes. Thus there are threats due to huge amount of pollutants reaching fresh water sources and make them unfit for human consumption and ecosystem processes. Wastewater discharged from industrial and urban areas can contain a wide variety of pollutants. This means that there will be high pollution level due to huge amounts of heavy metals, salts, nutrients and pathogens. Phytoremediation is an emerging technology that should be considered for the remediation of contaminated sites because of its aesthetic advantages and long-term applicability. This concept is an improvised

technique from the wetland system. The system is an alternative in wastewater engineering especially for water treatment process is complete. Plus, wetland system can operate by itself without much maintenance works (Aboyeji and Oluseun, 2013).

Phytoremediation means an environmentally sound technology for pollution prevention, control and remediation. Phytoremediation is the direct use of living green plants for in situ, o in place, removal, degradation, or containment of contaminants in soils, sludge, sediments, surface water and groundwater. Phytoremediation is a low cost, solar energy driven clean up technique. Besides that, it is the most useful at sites with shallow, low levels of contaminants. Other than that, it is useful for treating a wide variety of environmental contaminants and lasts, very effective with, or in some cases in place of mechanical clean-up methods. 'Phyto' means plant which is a generic term for the group of technologies that use plants for remediating soils, sludge, sediments and water contaminated with organic and inorganic contaminants (Agriculture Sciences, 2017)

1.2 Problem Statement

The population of the world has been increasing rapidly and to cope up with this a huge amount of food, energy and employment are required. Industrialization is the easiest way to meet up those demand. Nevertheless, the disposal of industrial wastewater is a great problem throughout the world. It may contain heavy metals as well as other pollutants (Abramov, 2014). The discarding of wastewater from industrial are harmful for the sustainable industrial approach (Changhao, 2013).

Industrialization is one of the major reason effect the water in Malaysia. There are many rivers affected by industrial activities. Semenyih river, Sungai Balok, Tunggak river, Galing river and Tiram river are main affected by industrialization. Thus it has disturbed the clean water or drinking water and it requires water treatment. Other than that, it has been facing problems of water quality status as the purposes and to contribute problem to aquatic environment.

According to previous study, Tiram River also been affected by industrial effluent. The Tiram River feeds into Kuantan River which is main outlet of the city of Kuantan. It receiving the industrial effluent without proper treatment which cause the level of toxic compound is high. Indera Mahkota and Kuantan area are expanding the development of industrial factories for offering job to the community as the number of

population grow wider at those areas. Thus, this caused widespread of polluted water. The amount of pollutant discharged to the water can no longer be accommodate by the water ecosystem. The effluent from industries is highly load with bad contaminant which bad odor at certain time. Musty or earth smell usually originating from dissolved solid in the water. Chemical smell can be due to chemical toxic seeping to the river. Besides that, the apparent colour of the river is chalky and milky. It happened from the existence of suspended matter. The way of human sight, the aesthetic value of Tiram River is bad (Asri, 2015)

Based on Mohammed Amjed Hossain and Dr Sujaul Islam Mir, Tunggak river is the major river that contributes in Pahang. This river is adjoining to Gebeng which is the main industrial area in Pahang state. Gebeng town is located near to Kuantan port, the place where industrial progress is developing speedily. These industrial activities are generating discharge that consist of huge concentrations of ordinary and non-ordinary pollutants that affect the water quality of the river. Industries such as medicinal, petrochemical, wooden and mining are the major contributors to the Tunggak river through drain or channels. The water quality becomes highly polluted because it contains nickel (Ni), Mercury(Hg), cadmium (Cd), zinc (Zn), Chromium(Cr), lead (Pb) and copper(Cu).

1.3 Significant of Study

There is still no complete solution for the water pollution at Semenyih river, Sungai Balok, Tunggak river, Galing river, Tiram river and Gebeng river. The research is still on process as the contamination of the river is high. The purpose of this study is to determine the concentration of pollutant that contain in industrial wastewater.

Surface water is being affected by major factor of industrial activities and also effect the surrounding environment. Phytoremediation is a technology to clean the environment from heavy metals contamination. Plants have the benefits to absorb the chemicals from polluted water. The economic success of phytoremediation greatly depends on photosynthetic activity and growth rate of plants. The application of phytoremediation in recent years has improved the environment using efficient and inexpensive in situ methods (Huesemann et al, 2009). Phytoremediation systems is effective as it is cheap, easy process and maintenance also favourably presence. *Scirpus*

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